

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

STOCKUM, WERNER ET AL.:

Group Art Unit: 1792

Serial No.: 10/526,497

Examiner: Nathan H. Empie

Filed: September 04, 2002

For: Etching Pastes for silicon surfaces and layers

DECLARATION UNDER 37 C.F.R. § 1.312

Honorable Commissioner of
Patents and Trademarks
Washington, D.C. 20231

SIR:

Werner Stockum, being duly warned, deposes and says:

I am a citizen of the Federal Republic of Germany residing at Reinheim, Germany;

I am a chemical engineer by training and experience;

I did complete my study as Chemical Engineer at the University of Applied Sciences in Darmstadt.

I joined Merck KGaA, Darmstadt / Germany in R&D Business Development Group in
5 1997.

Since 2006 I am R&D Manager in the new business unit - Liquid Crystals / Structuring Solutions.

10 I am author or co-author of following papers and patents in the fields of photovoltaics.

SIR:

Armin Kübelbeck, being duly warned, deposes and says:

I am a citizen of the Federal Republic of Germany residing at Bensheim, Germany;

I am a chemical engineer by training and experience;

I did complete my study as Chemical Engineer at the University of Applied Sciences in Darmstadt.

- 5 I joined Merck KGaA, Darmstadt / Germany as a product manager in the Electronic Chemicals division in 1998.

Since 2000 I am project manager in business development at Merck Chemicals.

- 10 I am author or co-author of following papers and patents in the fields of photovoltaics:

MADAM:

Sylke Klein, being duly warned, deposes and says:

I am a citizen of the Federal Republic of Germany residing at Roßdorf, Germany;

I am a chemist by training and experience;

The degree of Ph.D. (Dr.-Ing.) was bestowed on me by the Technical University of Darmstadt; Germany

Since August 16, 1999, I have started my contract at Merck KGaA, Darmstadt, Germany, since 2000 I am head of a chemical laboratory of Merck KGaA, Darmstadt, Germany.

I am author or co-author of following papers and patents in the fields of photovoltaics.

1. Etching pastes for inorganic surfaces (DE10101926(A1), US20030160026(A1), WO0183391(A1))
2. Combined etching and doping substances (DE10150040(A1), US20040242019(A1), WO2003034504(A1))
- 5 3. Printable medium for the etching of silicon dioxide and silicon nitride layers (DE102005007743(A1), WO2006074791(A1)) (and so on)
4. Investigation of Modified Screen-printing Al Pastes for Local Back Surface Field Formation," V. Meemongkolkiat, K. Nakayashiki, D. Kim, S. Kim, A. Shaikh, A. Kuebelbeck, W. Stockum, A. Rohatgi, Presented at the 4th World Conference on
10 Photovoltaic Energy Conversion; Hawaii, May 7-12, 2006.

Tests and Results

The results we gave are summarized in the following table.

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No.	Etching Paste	Exp.-No.	Etched Material	Etching Depth [nm]	Etching Temperature [°C]	Etching Time [s]
1	SolarEtchSID	ÄTZ-CT-05-02	Silicon (Si)	3000	200	120
2	Skorupski	ÄTZ-NK-5-1		300		
3	Yamazaki	ÄTZ-NK-5-2		20		
4	Ichinose	AM-04.26		100-130	170	300
5	Klein	WO 01/83391	Silicon Dioxide (SiO ₂)	120	30	300

[1] present application of Merck Patent GmbH, [2] Skorupski et al (US 2002/0162218), [3] Yamazaki (US 6,133,119), [4] Ichinose (US 5,688,366), [5] Klein (WO 01/83391)

The alkaline SolarEtchSID paste (ÄTZ-CT-05-02, containing KOH, [1]) for silicon etching is chemically identical with the etching paste of "patent Example 1". It is possible to etch selectively, e.g. it is possible to etch certain – sharply defined - patterns in the silicon material in certain depths.

As shown in the table the etching depth of SolarEtchSID paste (ÄTZ-CT-05-02) is much higher than the other patents, at least ten times higher than Skorupski [2]. Skorupski only discloses the roughening of metal surfaces (see example 7 and claims 27 and 28). When silicon surfaces are treated with compositions of Skorupski, the same result is achieved and the silicon surfaces are not etched to a consistent depth. This was already shown by micrographs sent together with our letter of February 4, 2009.

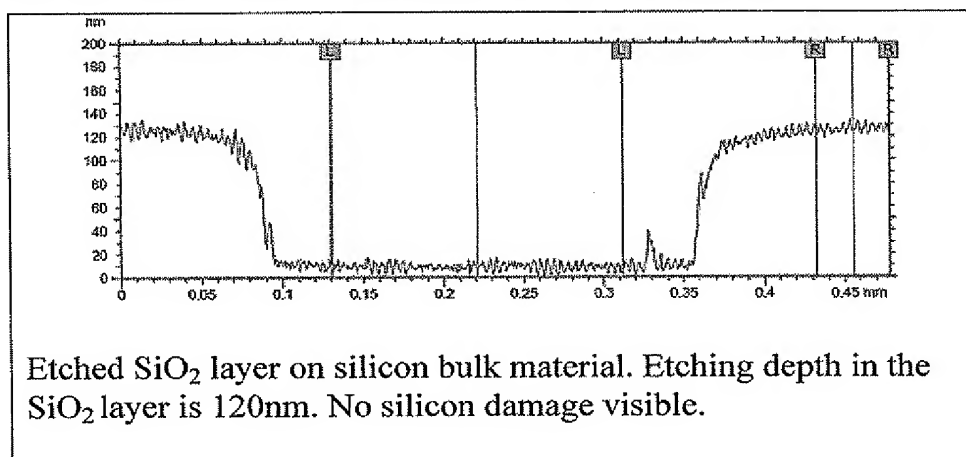
Yamazaki [3] only discloses the roughening of the surface, where the diffusion rate of the active etchant to the place of reaction at the surface plays a minor role, because the achieved depth of etching is not important.

As already pointed out the disclosure of Ichinose [4] is not suitable to be compared with the present invention, because this document discloses compositions comprising particulates whereas compositions of the present application have to be free of particles.

The etching parameters were only defined at 200°C and 120 s for comparing the results with Skorupski [2] (ÄTZ-NK-5-1). The reached etching depth of 3000 nm is valid for

both temperatures (200°C from comparison and 70-150°C as written in the U.S. Patent Application 10/526,497).

In contrast to this application, *Klein et.al.* [5] describes an acidic etching paste - containing NH_4HF_2 - for silicon dioxide. The etching depth is 120 nm. The etching temperature is 30°C. An etching temperature like 200°C as used for Si etching is not possible, because the etching paste - containing NH_4HF_2 - will be decomposed at temperatures >100°C under HF-evaporation. Additionally, the HF-gas will also etch the silicon dioxide and decrease the edge sharpness of etched patterns.




This etching paste does not etch the silicon material. So it can not be compared with examples [1-4] from the table.


I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date:

20.08.2003


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Werner Stockum


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Armin Kübelbeck


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Sylke Klein